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FOSSIL FAUNAS IN CENTRAL IOWA.

BY CHARLES R. KEYES.

Since the appearance of preliminary statements on the Lower Coal Measures of Central Iowa¹ some time ago, considerable additional material has been obtained, which presents some instructive considerations concerning the distribution of ancient life through that region. In the article alluded to thirty-five genera and nearly sixty species are mentioned. The present paper increases these figures to 51 and 84 respectively. There still remain many forms not yet sufficiently worked out for incorporation here. The interest, however, lies not so much in the numerical increase of the species discovered, as in the information imparted in regard to both the geologic and geographic range of the various types within, and without, the limits of the state; and in the exhibition, in many forms, of structural features which have hitherto been more or less obscure.

A recent geological reconnaissance of the locality has disclosed a large number of stations where animal life was at one time very prolific. Several new horizons have been definitely made out, on account of which the distribution in time of the various forms is capable of being traced with greater accuracy than has hitherto been possible.

In the earlier studies relating to the fauna of the Des Moines Coal Measures three striking facts were emphasized in particular. These may be summarized as follows:

(1.) In those zoological groups having an optimum habitat marine, there was not only a fewness of species but also an extreme paucity of individuals.

(2.) The Brachiopods, though well represented in both genera and species, were not as proportionately abundant as might be expected when it is remembered that this type of life had now nearly reached its greatest expansion and culmination.

(3.) The fauna was predominantly molluscan—more than three-fourths of the entire number of species being gasteropods and lamellibranchs.

The later observations fully corroborate the suggestions previously made and add further testimony as to the correctness of the conclusions already set forth.

¹ Proc. Acad. Nat. Sci., Phila., 1888, pp. 222-247.

Before passing to specific considerations, a brief sketch of the stratigraphy is perhaps necessary for a better understanding of the relations of the several faunas of the different horizons. A somewhat detailed section of the rocks as exposed at the locality in question, is represented in the subjoined scheme :

GENERAL SECTION OF ROCKS AT DES MOINES.

	Feet.	In.
26. Variegated clayey shales,	13	
25. Blue limestone, nodular, impure, weathering brown (F),	0	8
24. Variegated shales,	8	
23. Bituminous shales, with concretionary masses below (F),	3	
22. Coal,	2	
21. Light yellow and drab shales	7	
20. Variegated clayey shales	4	
19. Nodular limestone, earthy, passing in places into marl, highly fossiliferous (F),	0	6
18. Light colored and variegated clay-shales,	5	
17. Impure limestone, like No. 19, but not so fossiliferous (F),	0	10
16. Light colored, clayey shales,	5	
15. Soft micaceous sandstone, concretionary in places, and passing into sandy shales elsewhere,	25	
14. Light colored shales,	4	
13. Impure coal,	2	
12. Light and dark-colored clay-shales,	20	
11. Bituminous shales, highly fossiliferous (F.),	0	8
10. Coal,	2	
9. Fire clay,	1	
8. Variegated and sandy shales,	15	
7. Sandstone, massive,	6	
6. Coal,	4	
5. Fire clay,	2	
4. Variegated shales, sandy in places,	30	
3. Bituminous shales (F.),	5	
2. Coal,	5	
1. Fire clay,	1	

The beds above number 15 have been referred to the middle coal measures by St. John. They carry three thin bands of blue earthy limestone, nodular or fragmentary and weathering brown. Usually fossils are to be found in them, often quite abundantly. About a score of species have been thus far recognized from these layers. These calcareous bands are quite persistent over a wide area. The lower two are only five or six feet apart, while the third is about twenty-five feet higher. The clayey material between them appears

to decrease in thickness towards the southwestward. The triple calcareous bed exposed at the water's level on the Raccoon river at Commerce, eight miles from Des Moines may possibly represent the three bands. At that place they are only a few inches apart. In the immediate vicinity of Des Moines the following species have been obtained from these layers. It is to be noted that they are all typical marine forms; and that nearly all of them also occur in the dark shales of the lower coal measures, as has already been fully shown elsewhere, but their numbers and distribution in the lower horizons are very limited.

Rhombopora lepidodendroides Meek.

Lophophyllum prolificum McC.

Cyathophyllum torquium Owen.

Eupachyrinus cragini M. & W.

Synocladia biserialis Swallow.

Chonetes flemingi N. & P.

Chonetes mesoloba N. & P.

Rhynchonella uta Marcou.

Retzia mormoni Marcou.

Athyris argentea (Shepard.)

Productus semireticulatus Martin.

Productus muricatus N. & P.

Productus cora d'Orb.

Productus costata Sowerby.

Spirifera lineata Martin.

Spirifera camerata Martin.

Spirifera planoconvexa Shumard.

Spirifera kentuckensis Shumard.

Streptorhynchus crenistria Phillips.

The Middle Coal Measures at Des Moines cannot be well separated from the lower member, and the hitherto recognized line of demarkation is perfectly arbitrary. At best the group is of very doubtful utility. The thickness of the strata referred to the Middle Coal Measures in Iowa is in reality considerably less than was at one time supposed; while the vertical extent of the Lower Coal Measures has been found to be very much greater than it was regarded by White and others, who placed it at about two hundred feet.

A carefully made section was recently constructed along the line of the Des Moines River from Harvey in the east-central part of Marion county to Des Moines and from the latter place to De Soto along the Raccoon river—a distance of sixty-five miles. The detail of the strata from the top of the St. Louis limestone to the base of the Upper Coal Measures have thus been rather minutely worked out across that portion of the state referred to. In addition a large number of fossils were obtained from the several horizons, so that the vertical distribution of a large number of species was accurately determined within the limits of the region passed through. That part of the section in the immediate vicinity of the capital city of Iowa received particular attention with reference to the faunal zones.

It is to be noted that in the Lower Coal Measures of the region there is a marked absence of calcareous layers and for this reason the great paucity in the remains of truly marine forms is very

marked. The sandy material is also rather limited; and in it occur no organic remains except those of a few plants. Argillaceous deposits make up by far the greatest proportion of the formation. The clay-shales are ashen, drab or black in color; sometimes also red, yellow and blue. The light-colored shales are for the most part unfossiliferous, though occasionally fern impressions and casts of *Lepidodendron* roots are found. The dark colored bituminous varieties on the other hand are not unfrequently abundantly charged with fossils. As it has been shown elsewhere the coal of Central Iowa is deposited in numerous lenticular masses of greater or less extent. These beds may have a horizontal measurement from a few hundred yards to several miles. Usually a black shale of a few inches or a few feet in thickness immediately overlies the coal basins. It is these particular layers that are most highly fossiliferous. In many cases brilliant pyrite has replaced the hard parts of the fossils; but in others the calcareous matter has remained perfectly preserved, the pure white shells forming a striking contrast with the black matrix.

***Fusulina cylindrica* Fisher.**

Fusulina cylindrica Fisher, 1837: Oryct. du Gouv. de Moscou, p. 126, pl. xviii, figs. 1-5.

Fusulina cylindrica Owen, 1852: Geol. Sur. Wisc., Iowa and Minn., p. 130.

Fusulina cylindrica Meek. & Hayden, 1859: Proc. Acad. Nat. Sci., Philada., p. 24.

This is the first recognition of protozoan remains in the Lower Coal Measures of Des Moines. Their occurrence thus far has been confined to a single horizon, which is just below the lower member of the so-called middle section of the Iowa Upper carboniferous. The species is very widely distributed both in time and space, in consequence of which many varietal phases would be expected. There is, therefore, apparently very good grounds, as has been suggested by White, for regarding the various forms described as *Fusulina depressa*, *F. ventricosa*, *F. robusta*, *F. gracilis*, etc., identical with Fisher's species; the slight alleged differences being due rather to local variations in environment than to specific differentiations.

***Archæocidaris edgarensis* Worthen & Miller.**

Archæocidaris edgarensis Worthen & Miller, 1883: Geol. Sur. Illinois, vol. VII, p. 337, pl. xxx, fig. 15.

A few primary spines, which correspond in all particulars with those noted by Worthen and Miller from the Upper Coal Measures of Edgar county, Illinois, have been obtained in concretionary layers overlying a coal seam near the upper part of the Lower Coal

division. The echinoid remains from the Upper Carboniferous of America are exceedingly meagre, and much additional material is needed for comparative studies. The urchins of the Lower Carboniferous are much more satisfactory, but the great richness of the crinoidal faunas, that are always associated, has usually caused them to be, for the most part, overlooked.

As might be readily inferred, the remains of echinoderms are of rare occurrence in a locality having the lithological characters such as are presented in the district under consideration. Previous to the present announcement, the only known fossils of this group were a few segments of the stem and several brachial plates of *Eupachyrcrinus*. The latter were highly nodose but the nodosity was not extended into such long spines as in *E. cragini* which was found in limestone bands at the base of the Middle Coal Measures of the same locality.

***Chonetes lævis* Keyes.**

Chonetes glabra Geinitz, 1866: Carb. und Dyas in Nebraska, p. 60, t. iv, figs. 15-18. (Not Hall, 1857.)

Chonetes glabra Meek, 1872: U. S. Geol. Sur., Nebraska, p. 171, pl. iv, fig. 10; and pl. VIII, figs. 8a, 8b.

Chonetes lævis Keyes, 1888: Proc. Acad. Nat. Sci., Phila., p. 229, pl. xii, figs. 3a, 3b.

Chonetes geinitzianus Miller, 1890: N. A. Geol. and Palæ. p. 339.

In the original diagnosis of *Ch. lævis* the statement was made that it was probably the same shell as was described by Geinitz as *Ch. glabra* from the Upper Coal Measures of Nebraska. At that time comparisons could not be made to establish the identity of the two forms with any degree of certainty. The evidence now at hand, leaves little room for doubt in this respect. Geinitz's name, however, had been preoccupied by Hall in 1857 for a species from the Upper Helderberg. *Chonetes lævis* being the next available term must, therefore, be adopted; though Miller has more recently proposed the name *Ch. geinitzianus* for the same shell, which title, of course, must be regarded as a synonym.

Since the discovery at Des Moines of the eight specimens used in the original description large numbers of this species have been found near the same locality, scattered through a bed of bituminous shale fifteen feet in thickness. These are associated with its near congener *Ch. mesoloba*. The difference between the two species, as pointed out in the remarks accompanying the description of *Ch. lævis*, holds good throughout the entire series collected. Inasmuch as some of the specimens often show faint, radiating striæ it has

been suggested that these shells are merely water-worn individuals of other species. This, however, does not appear to be the case, since large numbers of *Ch. lævis* and *Ch. mesoloba* are found intimately associated; and in the latter the radiating striæ are very sharply defined and well preserved. Besides the conditions under which the shells existed show conclusively that all influences of wave action were absent during the burial of these organisms.

According to Meek this species has been recognized in boreal America on the shores of the Youkon river of Alaska.

Chonetes flemingi Norwood and Pratten.

Chonetes flemingi Norwood & Pratten, 1855: Jour. Acad. Nat. Sci., Phila., vol. III, p. 26, pl. ii, figs. 5a, -5e.

Chonetes verneuilliana Norwood & Pratten, 1855: Jour. Acad. Nat. Sci., Phila., vol. III, p. 26, pl. ii, figs. 6a, -e.

Chonetes verneuilliana Shumard, 1855: Geol. Sur. Missouri, p. 216.

Chonetes verneuilliana Meek, 1872: U. S. Geol. Sur. Nebraska, p. 170, pl. i, fig. 10a, -b.

There seems to be but little doubt that the two forms, considered specifically distinct, of Norwood and Pratten and by them called *Chonetes flemingi* and *Ch. verneuilliana* are identical. Careful comparisons of a large number of these forms from various localities in central Iowa show every conceivable gradation between the two so-called species. The peculiarities of *Ch. verneuilliana* as opposed to those of *Ch. flemingi* appear to be chiefly due to local differences of station. Moreover, the types of Norwood and Pratten's *Ch. verneuilliana* seem to be somewhat abnormal in their growth and therefore do not present the most characteristic features of the form.

Rhynchonella uta (Marcou).

Terebratula uta Marcou, 1858: Geol. N. A., p. 51, pl. vi, fig. 21a, -e.

Rh. (Camarophoria) osagensis Swallow, 1858: Trans. St. Louis Acad. Sci., vol. I, p. 219.

Camarophoria swallovia Shumard, 1858: Trans. St. Louis Acad. Sci., vol. I, p. 394, pl. xi, fig. 1a, e.

Camarophoria globulina Geinitz, 1866: Carb. und Dyas in Nebraska, p. 38, t. iii, fig. 5 (not *C. globulina* Phillips, 1834).

Rhynchonella osagensis Meek, 1872: U. S. Geol. Sur. Nebraska, p. 179, pl. i, fig. 9.

Rhynchonella osagensis Meek & Worthen, 1873: Geol. Sur. Illinois, vol. V, p. 571, pl. xxvi, fig. 22.

Rhynchonella uta White, 1875: Exp. and Sur. 100 merid., vol. IV, pt. i, p. 120, pl. viii, fig. 4.

The form under consideration is one of very wide distribution. The range of variation is quite extensive as is attested by the numerous specific terms that have been applied to it. Reference to a large series of specimens from localities widely separated geographically, appears to indicate that the synonymy of the species as already given, is probably correct, though other names may yet be

included. Notwithstanding the fact that *Terebratula uta* and *Rhynchonella osagensis* were proposed the same year, Marcou's name has priority of several months as has been satisfactorily shown by White. Geinitz referred this same form to the European *Cam-arophoria globulina* Phillips; but at present it does not seem advisable to consider the two forms as specifically identical. It is not improbable that the shell described by Marcou is the same as certain forms, known under other names, from the Lower Carboniferous rocks.

Lima retifera Shumard.

Lima retifera Shumard, 1858: Trans. St. Louis Academy Sci., vol. I, p. 214.

Lima retifera Geinitz, 1866: Carb. und Dyas in Nebraska, p. 36, t. ii, figs. 20 and 21.

Lima retifera Meek, 1872: U. S. Geol. Sur. Nebraska, p. 188, pl. ix, fig. 5.

The specimens collected at Des Moines and referred to this species consist only of a few fragments. Finely preserved examples have, however, been found not far from the locality mentioned and hence the species may be properly included in the fauna of the district. The true generic characters of the forms have not as yet been satisfactorily made out; and it is therefore with some hesitation that they are here allowed to remain under *Lima*.

Aviculopecten whitei Meek.

Aviculopecten whitei Meek, 1872: U. S. Geol. Sur. Nebraska, p. 195, pl. iv, fig. 11, a, b, c.

In the present state of confusion concerning the specific limits of the various forms of the genus it is difficult to satisfactorily make out the synonymy of the different species. The large number of individuals already described and referred to the genus will illustrate how cogent is the necessity for a thorough revision of the group. Different species have been based upon the right and left valves of the same shell. Others have attained specific distinction merely upon trivial variations of the "ears;" for it is now well known that in the majority of the species of the group these characters differ very much in the two parts of the same shell.

While the Des Moines specimens are manifestly identical with Meek's *A. whitei* the relationships to other forms cannot at this time be taken into consideration.

Avicula longa (Geinitz).

Gervillia longa Geinitz, 1866: Carbon. und Dyas in Nebraska, p. 32, t. ii, fig. 15.

Avicula longa Meek & Worthen, 1873: Geol. Sur. Illinois, vol. V, p. 578, pl. xxvi, fig. 1.

This species occurs very abundantly at Des Moines in the lower portion of the so-called Middle Coal Measures. It has not as yet

been recognized below this horizon, at least in Iowa. Westward the same form is found in the uppermost portion of the Upper Coal Measures and also in the Permian strata of early authors. It probably has a very much wider geographical range over the Mississippi basin than has hitherto been suspected.

Geinitz has intimated that Swallow's *Bakevellia pulchra* may be very closely related; but as the description of the latter is so unsatisfactory and is unaccompanied by figures it is not possible now to make out the exact relationships of the two forms.

Macrodon obsoletus Meek.

Macrodon obsoletus Meek, 1871: Rep. Reg. Univ., W. Va.

Macrodon obsoletus Meek, 1875. Geol. Sur. Ohio, Pal. vol. II, p. 334, pl. xix, fig. 9.

The bivalve under consideration was originally described from the Apalachian region, where it appears to be rather widely distributed through Pennsylvania, West Virginia and Ohio. But it has not before been recognized west of the Mississippi river. The Iowa shells are somewhat larger than those from the more eastern localities but do not differ essentially from the typical forms of the species. Meek's type specimen is a good cast showing the characters perfectly. The shell is radiately striated.

Nucula beyrichi Schauroth.

Nucula beyrichi Schauroth, 1854: Zeit. der Deut. Geol. Gesel., vol. VI, p. 551, t. xxi, fig. 4.

Nucula beyrichi Geinitz, 1866: Carb. und Dyas in Nebraska, p. 21, t. i, figs. 36, 37.

Nucula beyrichi Meek & Worthen, 1873: Geol. Sur. Illinois, vol. V, p. 589.

As remarked by Meek, there is some doubt as to the correct reference of the American forms of the group to the European species of Von Schauroth. Comparisons of the Iowa specimens of this species and *N. parva* of McChesney give no indication of the identity of the two shells as has been suggested at various times. One of the most striking differences between the two forms is the forward position of the beaks in the one and the central location of the umbones in the other. None of the Des Moines shells have been examined internally to ascertain the character of the hinge teeth and muscular impressions.

Schizodus alpina (Hall).

Dolabra alpina Hall, 1858: Geol. Iowa, vol. I, p. 716, pl. xxix, fig. 2.

Schizodus alpina Meek & Hayden, 1864: Palæ. Upper Mo., p. 58.

The original locality of *Schizodus alpina* is Alpine Dam on the Des Moines river. Hall referred the form with some doubt to

Dolabra; and it was not until some years afterwards that Meek & Hayden suggested that the shell belonged probably to *Schizodus*. As the specimens occur in Iowa, the shells are usually wanting; so that only internal casts are commonly met with.

***Pleurophorus permianus* Swallow.**

Pleurophorus permianus Swallow, 1858; Trans. St. Louis Acad. Sci., vol. I, p. 192.

Clidophorus pallasii Geinitz, 1866: Carb. und Dyas in Nebraska, p. 23, t. ii, fig. 3. (Not *Mytilus pallasii* de Vern., 1845.)

Pleurophorus occidentalis ? Meek, 1872: U. S. Geol. Sur. Nebraska, p. 212, pl. x, fig. 12. (Not *P. occidentalis* Meek & Hayden, 1858.)

The Des Moines forms appear to be the same as those described by Swallow as *Pleurophorus permianus*. And although the type is a cast the prominent ribs on the posterior slope leave little doubt as to its identity. The Iowa shells are, however, well preserved, showing all the minute details of structure.

Geinitz's figure 4 on tafel ii in his "Carbonformation und Dyas in Nebraska" is manifestly the same form; and cannot be regarded as de Verneuil's *Mytilus pallasii*. Meek, however, in the U. S. Geological Survey of Nebraska refers Geinitz's shells to *P. occidentalis* of Meek & Hayden; but there now seems to be considerable doubt as to the correctness of this view. In the Catalogue of American Paleozoic Fossils Miller has assigned all of Geinitz's forms to Meek's *P. oblongus*. This reference is only partly correct, inasmuch as Geinitz's *C. pallasii* embraces two distinct forms.

***Pleurophorus subcuneatus* Meek and Hayden.**

Pleurophorus subcuneatus Meek & Hayden, 1858: Trans. Albany Inst., vol. IV, p. 81.

Pleurophorus subcuneatus Meek & Hayden, 1864: Pal. Upper Mo., p. 66.

Pleurophorus simplus Geinitz, 1866: Carb. und Dyas in Nebraska, p. 24 (not of v. Keyserling).

There is but little doubt that the form from Des Moines is identical with that figured by Geinitz in 1866, as *Pleurophorus simplus* of Keyserling. Meek and Hayden had already described it under *P. subcuneatus*, but their figures are inaccurate and give a very erroneous conception of the real shape of the shell. This was, however, corrected by Meek in Dana's Manual of Geology.

***Astartella vera* Hall.**

Astartella vera Hall, 1858: Geol. Iowa, I, p. 715, pl. xxix, fig. 1.

The form under consideration was originally described from Iowa but since the appearance of the first diagnosis of the species more than thirty years ago little has been known of it within the limits of the state.

Although a thorough examination of all the forms described under the genus has not been made, the differences, as compared with *Astarte*, do not appear sufficiently great to give Hall's term a separate generic rank. Further comparisons may not, however, confirm this suggestion and hence until complete evidence is at hand *Astartella* should, perhaps, be allowed to stand as a valid generic group.

Dentalium annulostriatum Meek & Worthen.

Dentalium ? annulostriatum Meek & Worthen, 1870 : Proc. Acad. Nat. Sci., Phila., p. 45.

Dentalium ? annulostriatum Meek & Worthen, 1873 : Geol. Sur. Illinois, vol. V, p. 589.

Dentalium annulostriatum Keyes, 1888 : Proc. Acad. Nat. Sci., Phila., p. 234.

On a former occasion, the finding of six specimens of this species was recorded. Since that time a number of additional individuals have been obtained from higher horizons and associated with a similar fauna. The peculiar annular costæ which are so prominent and so characteristic of the species have given rise to the suspicion that these shells should more properly be assigned to a different genus than that to which they are now referred. However this may be, until a more critical study of the shells has been made, it is, perhaps, advisable to allow the form to remain under its original generic title. The character of the costæ are quite anomalous as compared with the surface markings of the other members of the group, while the great prominence of the annulations, as usually exhibited, is by no means as constant as might be supposed. In some individuals the rings are only faintly developed and the surface of the shells thus appears nearly smooth.

Dentalium meekianum Geinitz.

Dentalium meekianum Geinitz, 1866 : Carb. und Dyas in Nebraska, p. 13, tab. i, fig. 20.

Dentalium meekianum Meek & Worthen, 1873 : Geol. Sur. Illinois, vol. V, p. 590, pl. xxix, fig. 8.

Dentalium meekianum Keyes, 1888 : Proc. Acad. Nat. Sci., Phila., p. 234.

All the species of *Dentalium* described from the Upper Carboniferous of North America have been recognized at Des Moines. Half a dozen other forms have been noticed in the Lower Carboniferous of the Mississippi basin, while Whitfield has called attention to a single form from the Upper Helderberg. The latter is, therefore, the earliest form of the genus, now known from the American continent.

The species here recognized represent three distinct types of the genus: the first having the surface ornamentation composed of a

series of ridges transverse to the axis of the shell, thus forming annular elevations; in the second the costæ are much less prominent and are arranged obliquely or spirally; and the third has the ribs running longitudinally.

Dentalium sublæve Hall.

Dentalium obsoletum Hall, 1858: Geol. Iowa, vol. I, p. 724, pl. xxix, figs. 16, 17, 17a. (Not Schlotheim, 1832).

Dentalium sublæve Hall, 1877: Miller's Am. Palæ. Foss., p. 244.

The specimens recently obtained and referred to this species are somewhat smaller than the individuals originally figured by Hall. The longitudinal costæ are quite pronounced as might be expected in young and well-preserved shells. Inasmuch as Hall assigned no locality to the specimens described, more or less doubt must exist as to the exact identification of his species. But as the type specimens were probably among other material from Iowa, it is thought that the shells from the central part of the state represent younger individuals of the species in question. In the original description Hall gave the name *D. obsoletum* to the form under consideration, but that term had been preoccupied by Schlotheim nearly thirty years. The name was, therefore, in 1877, changed to the one it here bears.

This type of *Dentalium* has an exceedingly wide range in both time and space. Forms almost indistinguishable from the Carboniferous shells of Des Moines are found in the Eocene of the Gulf states and along the Atlantic coast.

Pleurotomaria modesta Keyes.

Pleurotomaria depressa Cox, 1857: Geol. Sur. Kentucky, vol. III, p. 569, pl. viii, figs. 10, 10a. (Not Passy, 1832).

Pleurotomaria modesta Keyes, 1888: Proc. Acad. Nat. Sci., Phila., p. 238.

Pleurotomaria kentuckensis Miller, 1890: N. A. Geol. and Palæ., p. 431.

At the time of the original diagnosis of *Pleurotomaria modesta* it was not known just what relation this form bore to Cox's *P. depressa* though it was stated that the two would probably prove identical. An examination of material other than that which was used in the previous notes leaves but little doubt that the two forms are specifically the same. The name *Pleurotomaria depressa*, however, was preoccupied by Phillips in 1836 and the term was also used by de Koninck and by Passy. *Modesta* therefore becomes the specific designation of the form. Miller has lately proposed the term *P. kentuckensis* for the same shell but this name, of course can only be placed as a synonym.

In the vicinity of Des Moines this species is now known to have a considerable vertical range. It occurs near the base of the lower coal measures and extends into the middle coal horizon. Its geographic range is also quite extensive.

Pleurotomaria carbonaria Norwood & Pratten.

Pleurotomaria carbonaria Norwood & Pratten, 1855: Jour. Acad. Nat. Sci., Phila., (2), vol. III, p. 75, pl. ix, fig. 8.

Pleurotomaria carbonaria Keyes, 1888: Proc. Acad. Nat. Sci., Phila., p. 239.

The original specimens of this species are from Williamson county, Illinois. A very similar form has been described from Newport, Indiana, under the name of *P. newportensis*. Apparently the only difference ascribed is that the latter has its revolving band raised instead of depressed. Further comparisons may eventually show this character is varietal rather than specific. This suggestion seems all the more plausible since many individuals which are unquestionably *P. carbonaria* have the band scarcely sunk below the surface.

Pleurotomaria sphærolata Conrad.

Pleurotomaria sphærolata Conrad, 1842: Jour. Acad. Nat. Sci., Phila., vol. VIII, p. 272, pl. xvi, fig. 12.

Pleurotomaria corenula Hall, 1852: Stansbury Exp. to Great Salt Lake, p. 413, pl. iv, fig. 4, f. 6a-d.

This form is the leading member of a widely distributed group of shells which manifestly belong to a single species but which in different parts of its range has received a variety of specific names. Notwithstanding, however, the many varietal phases exhibited there is always a peculiar constancy of characters by which the form is readily distinguished from other shells of the genus. In this country a very large number of species of *Pleurotomaria* have been described, embracing many diverse types. The same state of affairs also existed in Europe until de Koninck attempted to set aside the prevalent difficulties by breaking up the genus into several groups, which in fact are more or less easily separable even according to general shape. The original genus was thus greatly restricted and the various sections raised to an equal taxonomic rank. In its main aspects de Koninck's scheme will doubtless be found very convenient in its application to the American *Pleurotomariæ*. In this connection it may be further stated that the work along this line has already been partly done and the results thus far reached have been eminently satisfactory.

Pleurotomaria valvatiformis Meek & Worthen.

Pleurotomaria valvatiformis Meek & Worthen, 1866: Proc. Acad. Nat. Sci., Phila., p. 273.

Pleurotomaria valvatiformis Meek & Worthen, 1873: Geol. Sur. Illinois, vol. V, p. 602, pl. xxix, fig. 9.

The form under consideration is the smallest of the group yet observed in the Mississippi basin. It apparently belongs to the same section as the large *P. carbonaria* already mentioned. The species seems to have a much wider geographic range than has hitherto been suspected but owing to its small size has usually escaped notice.

Murchisonia quadricarinata (Worthen).

Loxonema quadricarinatum Worthen, 1884: Bul. 2, Illinois State Mus. Nat. Hist., p. 7.

Loxonema quadricarinatum Worthen, 1890: Geol. Sur. Illinois, vol. VIII, p. 140.

So manifestly different is Worthen's species from the forms of *Loxonema* that no hesitation is experienced in removing it from the genus under which it was originally described. While there is a probability amounting almost to certainty, of this shell being a true *Murchisonia*, all doubts as to its correct reference cannot be entirely removed until the apertural parts, which are in no specimens yet discovered perfectly preserved, can be thoroughly examined.

Bellerophon montfortianus Norwood & Pratten.

Bellerophon montfortianus Norwood & Pratten, 1855: Jour. Acad. Nat. Sci., Phila., (2), vol. III, p. 74.

Bellerophon montfortianus Geinitz, 1866: Carb. und Dyas in Nebraska, p. 8, tab. 1, fig. 13.

Bellerophon montfortianus Meek, 1872: U. S. Geol. Sur. Nebraska, p. 225, pl. xi, fig. 15.

Bellerophon montfortianus Keyes, 1888: Proc. Acad. Nat. Sci., Phila., p. 235.

Like several other members of this group *B. montfortianus* is widely distributed over the Mississippi basin; and also through the Appalachian region. Owing to the extreme delicacy of the shell it is rarely obtained in a good state of preservation. It may be characterized as follows:

Shell with inner whorls rather small; body turn greatly expanded toward the aperture; umbilicus nearly closed; aperture ample, more or less distinctly reniform; labial sinus rather narrow, deep; revolving band rather constricted, well defined, and depressed with a narrow median elevation. Outer lip extremely thin, regularly rounded on each side of the central cleft; much thickened towards the umbilicus. Inner lip well marked by a callous accumulation which is particularly prominent towards the middle. Surface

ornamented by numerous fine rounded filiform ribs running longitudinally, every third or fourth one of which is much more elevated than those lying between; these are crossed transversely by minute raised striæ. With the exception of the last half of the outer whorl the shell is also marked by large transverse, more or less broken ridges on each side of the median sulcus.

This beautiful species appears to be much more abundant in Pennsylvania, West Virginia and other portions of its eastern range, than in the region west of the Mississippi river, where it seems to be largely replaced by closely allied forms.

***Bellerophon urii* Fleming.**

Bellerophon urii Fleming, 1828: Brit. Anim., p. 338.

Bellerophon urii Norwood & Pratten, 1854: Jour. Acad. Nat. Sci., Phila., vol. III, p. 75, pl. ix, fig. 6.

Bellerophon carbonarius Cox, 1857: Geol. Sur. Kentucky, vol. III, p. 562.

Bellerophon blaneyanus McChesney, 1860: New Palæ. Foss., p. 60.

Bellerophon carbonarius Geinitz, 1866: Carb. und Dyas in Nebraska, p. 6, tab. i, fig. 8.

Bellerophon carbonarius Meek, 1872: U. S. Geol. Sur. Nebraska, p. 224, pl. iv, fig. 16; and pl. xi, 11a-c.

Bellerophon urii Keyes, 1888: Proc. Acad. Nat. Sci., Phila., p. 236.

The complete synonymy of this species has been given in the publication last referred to above, and therefore does not require further mention here. As stated on a former occasion there are apparently no good reasons for regarding the form usually called *B. carbonarius* as distinct from the familiar and widely distributed European *B. urii*. The American shell was early referred to *B. urii* by Norwood and Pratten; and it was not until some years later that Cox renamed the specimen. The number of longitudinal carinæ is exceedingly variable, fifteen to thirty being the usual limits, though in very large individuals the costæ often exceed the latter figure.

The geographic distribution of this species is very wide. Aside from its common occurrence in Europe it ranges in America from the eastern slope of the Apalachians to the Rocky mountains.

Bellerophon subpapillosus seems to be merely a local unimportant variation, perhaps an abnormal development. The papillæ are often recognizable on some of the Iowa shells. Certain of the latter individuals show this peculiarity even more distinctly than the type specimen itself; and from this extreme there are all gradations to perfectly smooth surfaces.

***Straparollus catilloides* (Conrad).**

Inachus catilloides Conrad, 1842: Jour. Acad. Nat. Sci., Phila., vol. VIII, p. 273, pl. xv, fig. 3.

Euomphalus rugosus Hall, 1858: Geol. Iowa, vol. I, p. 722, pl. xxix, fig. 14. (Not *E. regusos* Sowerby.)

Straparollus (*Euomphalus*) *subrugosus* Meek & Worthen, 1873: Geol. Sur. Illinois, vol. V, p. 607, pl. xxix, fig. 11.

Euomphalus rugosus White, 1884: Geol. Sur. Indiana, 13th Ann. Rep., p. 161, pl. xxxii, figs. 11, 12.

Euomphalus rugosus Keyes, 1888: Proc. Acad. Nat. Sci., Phila., p. 241.

There appears to be but little doubt that the form described by Conrad from the region east of Apalachians as *Inachus catilloides* and *Euomphalus rugosus* of Hall are identical. Although Conrad's original diagnosis is very brief, his figure shows clearly what shell he had under consideration. A careful comparison of a large series of Pennsylvania specimens and those from the Mississippi basin fails to bring out any difference sufficiently great to warrant a specific separation of the shells from the two localities. This form is commonly known throughout the continental interior under Hall's name. His designation, however, is preoccupied by Sowerby; and for this reason Meek & Worthen proposed *subrugosus* for the specific term. After all, it is very probable that the form in question should properly be regarded as identical with a certain European species; and further comparison may necessitate the merger of the two species now regarded valid.

Straparollus catilloides as now understood is widely distributed geographically, being one of the most abundant and characteristic shells of the Lower Coal Measures. It occurs usually in the dark bituminous shales overlying the coal seams associated with other gasteropodous species. It often attains a very considerable size though seldom does the maximum measurement exceed twelve millimeters. At Des Moines the vertical range of this species is from the base to the top of the Lower division of the Coal Measures; it is also met with in the so-called middle section at Van Meter in Dallas county near the base of the Upper Coal Series; and very probably extends considerably higher. The form has not as yet been recognized in the Lower Carboniferous of the state, but its very different habitat may easily account for its absence.

***Straparollus pernodosus* Meek & Worthen.**

Straparollus (*Euomphalus*) *pernodosus* Meek & Worthen, 1870: Proc. Acad. Nat. Sci., Phila., p. 45, pl. xxix, figs. 14a-c.

Straparollus (*Euomphalus*) *pernodosus* Meek & Worthen, 1873: Geol. Sur. Illinois, vol. V, p. 604, pl. xxix, figs. 14a-c.

Euomphalus pernodosus Keyes, 1888: Proc. Acad. Nat. Sci., Phila., p. 241.

The species of this group occurring in central Iowa belong properly to the section with angular whorls, to which Sowerby gave

the generic term *Euomphalus*. The relations of the forms heretofore generally referred to Sowerby's section and those belonging to Montfort's genus *Straparollus* have already been pointed out at length.¹ It has thus been satisfactorily shown that the two genera are practically co-extensive and as Montfort's term has priority it must be adopted for the group of paleozoic gasteropods distinguished by having the shell rather thick, planorbiform, or depressed conical, broadly and deeply umbilicated; whorls angular or rounded, usually closely coiled, but often barely in contact; aperture sharply pentagonal or sub-circular; labium generally sharp. The surface of the volutions is for the most part smooth, or showing only numerous lines of growth; but sometimes with one or more distinct longitudinal carinæ.

In Iowa the transition forms between the two sections above alluded to are fully represented in certain species of the Kinderhook and Burlington formations. The gradations are complete from those species having elevated spires and rounded volutions—like *S. macromphalus* Winchell—to those with depressed spires and angulated whorls—as *S. roberti* (White). In the latter examples the turns are flattened above and the extremity of the spiral portion situated midway between the upper and lower planes of the volutions. The shell is thus perfectly planorbiform with one side angular and the other rounded.

Naticopsis nana (Meek & Worthen).

Platystoma nana Meek & Worthen, 1860: Proc. Acad. Nat. Sci., Phila., p. 463.

Naticopsis nana Meek & Worthen, 1866: Geol. Sur. Illinois, vol. II, p. 365, pl. xxxi, fig. 4.

This minute form was originally described under *Platystoma*; and there is yet reason for believing that it may actually belong to that group instead of *Naticopsis*, as Meek & Worthen afterwards thought. Should further study indicate that the species is actually a member of the first group its name becomes *Strophostylus nana* since it has been recently shown that *Strophostylus* must be applied to the *Platystoma* section as founded by Conrad.

Trachydomia wheeleri (Swallow).

Littorina wheeleri Swallow, 1860: Trans. St. Louis, Acad. Sci., vol. I, p. 658.

Naticopsis (Trachydomia) wheeleri Meek & Worthen, 1866: Geol. Sur. Illinois, vol. II, p. 364.

Naticopsis wheeleri Meek & Worthen, 1873: Geol. Sur. Illinois, vol. V, p. 595, pl. xxviii, fig. 3.

¹ Proc. Acad. Nat. Sci., Phila., 1889, p. 291; also Am. Geol., vol. V, p. 193-197.

Naticopsis wheeleri White, 1884: Geol. Sur. Indiana, Ann. Rept. for 1883, pt. ii, p. 162, xxxii, figs. 13, 14.

Trachydomia nodulosa Worthen, 1884: Bul. No. 2, Illinois State Mus. Nat. Hist., p. 8.

Trachydomia wheeleri Keyes, 1889: American Geologist, vol. IV, p. 195.

Trachydomia wheeleri Keyes, 1890: The Nautilus, vol. IV, p. 30.

Trachydomia nodulosa Worthen, 1890: Geol. Sur. Illinois, vol. VIII, p. 146, pl. xxiii, figs. 11, 11a.

Trachydomia was originally proposed by Meek & Worthen in 1866 as a subgenus of *Naticopsis* McCoy. It is now believed that the characters are sufficiently well marked to admit of a distinct generic separation from McCoy's genus. The chief features distinguishing the two sections as recently made out may be here briefly restated. In *Naticopsis* proper, as represented by the typical forms, and by the majority of American species referred to the genus, the shells are relatively thin; the spire very short; the outer lip extremely thin and sharp; the inner lip also thin and slightly depressed; the last volutions generally more or less distinctly flattened or concave on the upper half and marked toward the suture by numerous small, short, equidistant costæ, parallel to the lines of growth. In contradistinction, the shells of *Trachydomia* are massive with the spire larger and more elevated, the outer lip very thick, but abruptly becoming sharp; the columella very heavy, the callosity thick and greatly extended; the volutions covered with numerous equidistant nodes.

The first species of this group described from the American paleozoic rocks was called by Swallow *Littorina wheeleri*. Since the appearance of Swallow's notice, three other forms have been given specific names: *T. nodosa*, which was regarded by Meek & Worthen as the type of the genus; *T. hollidayi* Meek & Worthen, and *T. nodulosa* Worthen. Now the known shells of this type have a very wide geographical distribution, occurring at numerous places in Illinois, Iowa, Missouri, Kansas and, according to White, also in New Mexico. A careful comparison of a considerable number of shells from widely separated localities leads to the conclusion that the known forms of *Trachydomia* should all be referred to two species—*T. wheeleri*, the one earliest described, and *T. nodosa*. The various slight modifications in size, number of nodes, and amount of callous material deposited can all be explained by local differences in environment. And the complete intergradation of the several forms renders this view necessary.

The callosity of the inner lip often becomes very much thickened in some individuals, but this prominence is not conspicuous in the

majority of examples. It is interesting to note in this connection that among the shells from Illinois, there are a number in which the coloration of the callous portions and of the interior surface is still visible. In some cases the color is an intense shining black; in some a purplish-black; in others a dull faded purple; and in a few the color has nearly disappeared. Aside from the apertural parts, all traces of the original coloration of the shells are lost. Under the ordinary circumstances of fossilization, the color could hardly be expected to be preserved except in rare cases; and the few recorded instances of paleozoic species retaining such characters are of peculiar interest.

***Aclisina minuta* (Stevens).**

Aclis minuta Stevens, 1858: Am. Jour. Sci., (2), vol. xxv, p. 259.

Aclisina minuta de Koninck, 1881: Ann. de Mus. Roy. d'Hist. Nat. de la Belgique, T. VI.

Aclisina minuta Keyes, 1888: Proc. Acad. Nat. Sci., Phila., p. 240.

The form under consideration was first noticed by Stevens as *Aclis minuta*. In 1881, de Koninck established the genus *Aclisina* for the *Turritilla striatula* group of shells, which also embraced *Aclis minuta* and several other American forms. In this country the shells are all quite minute and at present are unknown except in the Coal Measures. On account of this small size these gastropods have usually escaped notice; and it is for this reason probably that they have been reported from so few localities. As has been remarked elsewhere they occur quite commonly at Des Moines in company with vast numbers of other minute mollusca.

***Loxonema scitula* Meek & Worthen.**

Loxonema scitula Meek & Worthen, 1860: Proc. Acad. Nat. Sci., Phila., p. 464.

Loxonema rugosa Meek & Worthen, 1860: Proc. Acad. Nat. Sci., Phila., p. 465.

Loxonema scitula Meek & Worthen, 1866: Geol. Sur. Illinois vol. II, p. 377, pl. xxxi, figs. 10a-c.

Loxonema rugosa Meek & Worthen, 1866: Geol. Sur. Illinois, vol. II, p. 378, pl. xxxi, figs. 11a-c.

There have been described from the Coal Measures of the Mississippi basin several species similar to the one under consideration. At first glance the vertical costæ appear perfectly straight instead of arched as in the more typical forms of the genus. Upon a closer examination, however, the ribs are found to curve considerably. The relatively much larger size of the rounded ridges in this section of the genus as compared with the Devonian forms tends greatly to obscure the actual curvature.

The figures accompanying the reprint of the original description, in the second volume of the Illinois Geological Survey, are misleading in one particular; that is in having the costæ arranged directly above one another, on the contiguous whorls. In the same place the statement is also made that this is the case. Closer observation has clearly shown that this arrangement is more apparent than real; and that actually the ridges of the different turns are set slightly behind those of the preceding volution; so that in place of forming a perfectly straight, though interrupted ridge from the apex to the middle of the body-whorl, the long rounded elevation is somewhat spirally twisted.

The number of costæ varies with the size and maturity of the shell. Usually there are from three to four ribs less on each whorl than on the one immediately succeeding. Thus the eighth volution may have twenty-two or twenty-four rounded ridges while the fourth has only twelve or thirteen. Below the middle of the whorls the costæ rapidly diminish both in height and breadth and are continued as minute hair lines. The aperture is oval in outline, slightly flattened on the side towards the axis. The inner lip springs abruptly from the callous portion instead of gradually blending with it at a low angle, but otherwise this species possesses all the characteristics of the typical form of *Loxonema*.

At Des Moines this species has as yet been found only at a single horizon—near the top of the Lower Coal Measures.

Loxonema multicosta Meek & Worthen.

Loxonema multicosta Meek & Worthen. 1866: Geol. Sur. Illinois, vol. II, p. 378, pl. xxxi, fig. 12.

The remarks upon *L. scitula* are largely applicable to this species also. The costæ are much smaller as a rule and they average about one-third more than on corresponding whorls of the other species. The number on the last volution may thus be thirty or more. This form is associated with the last and like that species has only been found at a single horizon.

Soleniscus newberryi (Stevens).

Loxonema newberryi Stevens, 1858: Am. Jour. Sci., (2), vol. xxv, p. 259.

Macrocheilus newberryi Hail, 1858: Geol. Iowa, vol. I, p. 719, pl. xxix, fig. 1.

Soleniscus planus White, 1881: Expl. & Sur., W. 100 Merid., Supp., vol. III, p. xxix, pl. iv, fig. 4.

Macrochilina newberryi de Koninck, 1881: Ann. de Mus. Roy. d'Hist. Nat. de la Belgique, t. VI, p. 36.

Soleniscus newberryi White, 1884: Geol. Sur. Indiana., 13th Ann. Rep., pt. ii, p. 153, pl. xxxiv, figs. 7, 8.

Macrocheilus newberryi Keyes, 1888 : Proc. Acad. Nat. Sci., Phila., p. 240.

Soleniscus newberryi, Keyes, 1889 : Proc. Acad. Nat. Sci., Phila., p. 308.

Soleniscus newberryi Keyes, 1889 : Am. Naturalist, vol. XXIII, p. 423, pl. xx, fig. 5.

Considerable confusion has long existed among the shells for which Phillips long ago proposed the name *Macrocheilus*. The difficulties encountered in arriving at a correct nominal history of the genus have been recently treated of at length. The more salient points may be briefly summarized here.

Macrocheilus was founded by Phillips¹ in 1841. Under it were arranged six species, three of which were *Buccinum breve* Sowerby, *B. imbricatum* Phillips and *B. acutum* Sowerby. Phillips, however, expressly stated that the first two of these properly belong to other groups and that the third was regarded as more typical. *B. acutum* hence becomes the type of the genus, as it was rightly considered by de Koninck and other European writers. An examination of many specimens of Sowerby's *Buccinum acutum* shows that the shell possesses a more or less thickened lip and a prominent revolving fold on the columella. The latter feature was long ago recognized by de Koninck.² It thus appears that Sowerby's form is in all respects a typical *Soleniscus* as defined by Meek and Worthen³; and that, therefore, this genus and *Macrocheilus* are identical.

But Phillips' term *Macrocheilus* was preoccupied by Hope in 1838 for a genus of insects and, therefore, becomes unavailable. Conrad, in 1842, proposed *Plectostylus* for a group of fossil gasteropods which evidently belonged to *Macrocheilus*; but this name also had been used by Beck five years before. In 1860, Meek and Worthen founded the genus *Soleniscus*, for certain paleozoic shells which now are known to be very closely related to the type of *Macrocheilus*. Inasmuch as the latter term had been previously used, Boyle, in 1879, substituted the name *Duncania*, which he afterwards changed to *Macrochilina*. From the foregoing, it is, therefore, manifest that the generic title *Soleniscus* has precedence for the *Macrocheilus* group, as typified by *Buccinum acutum* Sowerby and *Soleniscus typicus* Meek & Worthen.

¹ Palæ. Foss. Cornwall, p. 103.

² Desc. des Anim. Foss. de Belgique, 1844, p. 474.

³ Proc. Acad. Nat. Sci., Phila., 1860, p. 467.

Soleniscus humilis (Keyes).

- Macrocheilus humilis* Keyes, 1888 : Proc. Acad. Nat. Sci., Phila., p. 239.
Soleniscus humilis Keyes, 1889 : Am. Naturalist, vol. XXIII, p. 423.
Soleniscus humilis Keyes, 1889 : Proc. Acad. Nat. Sci., Phila., p. 308.
Macrochilina humilis Miller, 1890 : N. A. Geol. & Palæ., p. 409.

With the exception of the finding of a few additional specimens since the first record of the form no further information has been obtained concerning this species.

Soleniscus gracilis (Cox).

- Macrocheilus gracile* Cox, 1857 : Geol. Sur. Kentucky, vol. III, p. 570.
Macrocheilus gracile Keyes, 1888 : Proc. Acad. Nat. Sci., Phila., p. 239.
Soleniscus gracilis Keyes, 1889 : Am. Naturalist, vol. XXIII, p. 423.
Soleniscus gracilis Keyes, 1889 : Proc. Acad. Nat. Sci., Phila., p. 307.
Macrochilina gracilis Miller, 1890 : N. A. Geol. & Palæ., p. 409.

Until quite recently this little shell seems to have been generally overlooked. Even when noticed it has been usually referred to *S. ventricosus* of Hall. The two forms are certainly very closely related but whether they will eventually prove identical or not cannot be decided at present. As remarked in another place, the smaller specimens are less ventricose and have the spire proportionally much higher than in older individuals, which simulate, somewhat, Hall's species above alluded to. As a matter of fact the latter form has been recognized only in a few instances; while its name has been applied to a very considerable number of shells which are manifestly quite different specifically.

Soleniscus paludinæformis (Hall).

- Macrocheilus paludinæformis* Hall, 1858 : Geol. Iowa, vol. I, p. 719, pl. xxix fig. 10.
Soleniscus paludinæformis White, 1884 : Geol. Sur. Indiana, 13th Ann. Rep., p. ii, p. 154.
Soleniscus paludinæformis Keyes, 1889 : Proc. Acad. Nat. Sci., Phila., p. 308.

Perhaps the only question of synonymy in connection with this species is its possible identity with Conrad's *Plectostylus hildrethi*. The type of the latter, however, appears to be merely an internal cast which fact makes it almost impossible to determine the exact relationship of the two forms. In any case it is not probable that under these circumstances Conrad's name could in any way be made to supplant Hall's species.

Sphærodoma medialis (Meek & Worthen).

- Macrocheilus mediale* Meek & Worthen, 1860 : Proc. Acad. Nat. Sci., Phila., p. 466.
Macrocheilus pulchellum Meek & Worthen, 1860 : Proc. Acad. Nat. Sci., Phila., p. 467.
Macrocheilus intercalare Meek & Worthen, 1860 : Proc. Acad. Nat. Sci., Phila., p. 467.

Macrocheilus mediale Meek & Worthen, 1866: Geol. Sur. Illinois, vol. II, p. 370, pl. xxxi, figs. 5a-b.

Macrocheilus intercalare Meek & Worthen, 1866: Geol. Sur. Illinois, vol. II, p. 371, pl. xxxii, figs. 6a-b.

Soleniscus medialis White, 1884: Geol. Sur. Indiana, 13th. Ann. Rep., p. ii, p. 156.

Sphærodoma medialis Keyes, 1889: Proc. Acad. Nat. Sci., Phila., p. 306.

Macrochilina medialis Miller, 1890: N. A. Geol. & Pal., p. 409.

The generic relations of *Sphærodoma* have already been fully discussed elsewhere. In contradistinction to the nearest allied genus, *Soleniscus*, the shells of this group have the volutions very convex, the spire greatly depressed, the body-whorl relatively much larger and the aperture correspondingly ample, while the columellar ridge is usually very obtuse or not defined. These forms are commonly found in the calcareous beds, while their fusiform relatives occur most plentifully in bituminous shales; the inference is, that the former were probably more strictly marine than the latter.

***Bulimorpha minuta* (Stevens).**

Loxonema minuta Stevens, 1858: Am. Jour. Sci., (2), vol. XXV, p. 260.

Acteonina minuta Meek & Worthen, 1873: Geol. Sur. Illinois, vol. V, p. 594, pl. xxxix, fig. 2.*

Acteonina minuta Keyes, 1888: Proc. Acad. Nat. Sci., Phila., p. 240.

Bulimorpha minuta Keyes, 1889: Proc. Acad. Nat. Sci., Phila., p. 301.

The reasons for considering this species under *Bulimorpha* have already been fully stated. A further examination of the form appears to indicate that the inner lip actually is separated from the outer labrum by a distinct notch. Its nearest ally is, therefore, *B. canaliculata* (Hall). In regard to the generic relations, it may be said that the assemblage, of which this little shell is one of the members, embraces those American forms having the shell fusiform, with the spire elongated; the whorls more or less decidedly convex, the last rather large; the columella curved, abbreviated or truncated at the base; the inner lip often well defined anteriorly, and usually separated from the outer by a more or less well-marked notch; surface smooth. Accordingly, this group would include not only those forms originally comprehended under the genus *Bulimella* established by Hall but also certain other species. Some of the forms now recognized as belonging to the section have been assigned to Portlock's *Polyphemopsis*, but there is reason to believe that this term is not correctly applicable to any known American gasteropod. Hall's *Bulimella* is preoccupied by Pfeiffer and it is, therefore, necessary to find some other more appropriate term for

the group in question. *Bulimorpha* founded by Whitfield is apparently the only available name for these shells, but whether this title can be eventually considered valid cannot now be decided.

Bulimorpha ? chrysalis (Meek & Worthen).

Polyphemopsis chrysalis Meek & Worthen, 1866 : Proc. Acad. Nat. Sci., Phila., p. 267.

Polyphemopsis chrysalis Meek & Worthen, 1873 : Geol. Sur. Illinois, vol. V, p. 596, pl. xxviii, fig. 7.

Bulimorpha chrysalis Keyes, 1889 : Proc. Acad. Nat. Sci., Phila., p. 300.

Inasmuch as *Polyphemopsis* is not recognized as an American genus the species under consideration can only be referred to *Bulimorpha* provisionally, until its generic position is more definitely known. The Des Moines specimens are not preserved sufficiently well to indicate the true structure of the anterior part of the shell. The species somewhat resembles *Soleniscus newberryi* (Stevens) but according to Meek & Worthen, it does not exhibit the columellar fold so characteristic of that group.

Goniatites nolenensis Cox.

Goniatites nolenensis Cox, 1857 : Geol. Sur. Kentucky, vol. III, p. 574.

The single specimen from Des Moines is in an excellent state of preservation and shows the minutest details of structure. And while it does not agree exactly with Cox's diagnosis referred to above, there does not seem to be any valid reason for regarding it as anything more than merely an individual variation of *G. nolenensis*. The Des Moines specimens come from the base of the Middle Coal Measures. At the same locality, but at a horizon considerably lower, have been found abundant remains of a large Goniatite having a maximum diametric measurement of fully six inches. None of these large shells, however, have as yet been obtained sufficiently well preserved for accurate descriptive purposes.

Nearly a score of species of *Goniatites* have been recognized in the coal measure strata of the continental interior. These are widely distributed geographically from the Rockies to the Appalachians. Many of them were of large size and rivaled the Nautiloid forms which also flourished throughout the region.

Thrinacodus duplicatus ? (Newberry & Worthen).

Diplodus duplicatus Newberry & Worthen, 1866 : Geol. Sur. Illinois, vol. II, p. 61, pl. iv. figs. 3, 3a.

Thrinacodus duplicatus St. John & Worthen, 1875 : Geol. Sur. Illinois, vol. VI, p. 289.

The specimens under consideration were obtained at the now abandoned Giant Mine. They do not agree in all particulars with

the typical forms of the species, as the denticles are somewhat large, more slender and much longer. They are associated with numerous molluscan shells.

Deltodus intermedius St. John & Worthen.

Deltodus intermedius St. John & Worthen, 1883 : Geol. Sur. Illinois, vol. VII, p. 153, pl. ix, figs. 14, 15.

It is with some doubt that the species in hand is referred to this species which was described from the St. Louis limestone at Pella, Iowa. It corresponds, however, in all essential particulars.

The results thus far brought out may be summarized in the following.

Synoptical Table of Genera and Species.

Protozoa	Rhizopoda	genera	1	species	1
Coelenterata	Anthozoa	"	2	"	2
Echinodermata	Crinoidea	"	1	"	1
	Echinoidea	"	1	"	1
Molluscoidea	Bryozoa	"	1	"	1
	Brachiopoda	"	10	"	16
Mollusca	Lamellibranchiata	"	12	"	18
	Gasteropoda	"	15	"	31
	Cephalopoda	"	3	"	7
Arthropoda	Crustacea	"	2	"	2
Vertebrata	Pisces	"	3	"	4

A comparison of the above table with a similar one given on another occasion confirms still more strongly the conclusions arrived at at that time. The present additions are nearly entirely confined to the true mollusks, the previously known numbers of genera and species from the locality being nearly doubled ; while very little, or no gain is apparent in the other groups.